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## A Method for Determining Strategic Groups and Life Cycle Stages of an Industry

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# A Method for Determining Strategic Groups and Life Cycle Stages of an Industry

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Abstract

For some time it has been accepted that products go through stages in a life cycle. In a similar way, firms and industries are also thought to move through life cycles. Yet, the concept is somewhat ambiguous and not much is known about the nature of the life cycle or how it affects firms in a particular industry. The purposes of this study are to present an approach for gaining a better understanding of the industry life cycle and to suggest a method for developing hard data for gaining a better understanding of the concept.

## INTRODUCTION

For some time it has been accepted that products go through stages in a life cycle. In a similar way, firms and industries are also thought to move through life cycles. Yet, the concept is somewhat ambiguous and not much is known about the nature of the life cycle or how it affects firms in a particular industry. The purposes of this study are to present an approach for gaining a better understanding of the industry life cycle and to suggest a method for developing hard data for gaining a better understanding of the concept.

## PREVIOUS STUDIES

### The Life Cycle

The importance of both the industry life cycle and strategic group concepts is well documented in the strategic management and policy literature. Porter (1980: 157) explains that there is some controversy about whether the life cycle applies only to individual products or to whole industries.[1] In this reference Porter takes the position that the life cycle applies to industries. The notion is that industry growth follows an S shaped curve because of the process of innovation and diffusion of new products. He also explains that the life cycle concept has attracted some criticisms. First, the length of the stages varies widely from industry to industry; it is often not clear what stage of the life cycle an industry is actually in. Porter (1980: 158). The usefulness of the concept as a planning tool, according to Porter, is diminished because of this problem. A second criticism is that industry growth does not always go through the S shaped curve. Sometimes stages are skipped and sometimes industry growth revitalizes after a period of decline. Porter (1980: 158). The third criticism of the industry life cycle is that companies can affect the shape of their

growth curve through product innovation and repositioning. Porter (1980: 162). Porter explains that if a company takes the life cycle as given, it becomes an undesirable self fulfilling prophesy. Patz (1981: 127-30), Rumelt (1979: 204-206; 208-209; 211-212; 215), Cooper (1979: 318-325) also discuss the industry life cycle as it relates to strategic management.

Porter (1980: 162) also explains that the nature of competition associated with each stage of the life cycle is different for different industries. Some industries start off highly concentrated and remain so; others are concentrated for a significant period and then change to a lower level of concentration. Others begin highly fragmented; later some consolidate and some do not. Although Porter does not make any reference to the fact, these changing patterns may have significant implications for strategic groups within an industry. This possibility will be discussed later. Porter also mentions that the same changing patterns apply to advertising, R & D expenditures, degree of price competition, and most other industry characteristics. Moreover, he argues that "Divergent patterns such as these call into serious question the strategic implications ascribed to the life cycle." Porter (1980: 162).

## The Strategic Group Concept

Newman (1978: 417-27) and Porter (1979: 215-227) both discuss the strategic group concept. Although these studies investigated different questions, they are both concerned with the importance of examining strategic groups within a given industry instead of the group as a whole to obtain more meaningful information concerning firm strategy.

> If corporate strategies can differ persistently among direct market rivals, we can speak of strategic groups--each group consisting of firms highly symmetrical in their corporate strategies--as a stable element of market structure. Newman (1978: 417-427).

Porter (1979: 215) explains that an industry is composed of a cluster of firms, each group following similar strategies in terms of key decision variables. The group may consist of a single firm or all firms in the industry.

The dynamics described by Porter (1980: 162 & 136) could lead one to the conclusion that strategic groups could be different for each phase of an industry's life cycle; this conclusion follows from his discussion. He further explains that an industry may contain several strategic groups. Entry barriers protect members of a strategic group from entry by an outside firm and also provide barriers to members of an industry shifting strategic positions from one strategic group to another. Porter (1980: 133).

Rumelt (1979: 204-206; 208-209) mentions both the life cycle models and the strategic group models as fruitful areas for further research. He acknowledges that the strategic group concept represents a beginning of the move away from equating structure with concentration but he explains that further work is required. Regarding the life cycle concept, he says that the application of a Hatten-Patton type of method to a competitive group in the growth phase and then again in the maturity phase of the life cycle would be a worthy study. Rumelt (1979: 212). The objective of this particular study is different from Hatten and Patton's studies; however, this work does represent an attempt to integrate strategic group theory into industry life cycle theory. Moreover, it provides an attempt to establish a technique which will be useful for determining the phase of the life cycle an industry is in, at a point in time, without requiring previous or future information.

## THE THEORY

### The Industry Life Cycle

Firms and industries go through a life cycle similar to that attributed to products which is described in Rink and Swan (1979: 219-242). Grabowski and Mueller (1975: 401) argue that investment behavior by a firm follows a life cycle. Kmenta and Williamson (1966: 172-181), in their study of the railroad industry, established that investment in that industry did follow a life cycle pattern which consisted of a three stage pattern; an early period of adolescence (1872-1895), a middle period of maturity (1896-1914) and "...discarding the unusual war years of governmental control a final period of senility, 1922-1941." Kmenta and Williamson (1966: 173).

These studies seem to provide adequate bases for a life cycle which causes firms within an industry to adjust their investment strategy.

The life cycle behavior of investment is inherent in the table in Porter (1980: 160). The author attributes to Patton (1959) the idea that in the growth stage undercapacity would occur and to Staudt, Taylor and Bowersox (1976) along with Wells (1972) the notion that a shift toward mass production would be expected in that stage.

Porter (1980: 160) also attributes to the maturity stage some overcapacity, according to Levitt (1965); and a movement toward optimum capacity, according to Smallwood (1973). Porter's table also shows stability of the manufacturing process, according to Catry and Chevalier (1974); and movement toward long production runs with stable techniques, according to Wells (1972), in the mature stage of the life cycle.

Porter (1980: 160) states that for the decline stage of the life cycle substantial overcapacity would exist, from Levitt (1965) and Patton (1959).

The significant thing for our purpose is to note that these characteristics and conditions cited by previous authors would all affect investment strategy within a firm and within an industry, as an industry moves from one stage of the life cycle to another.

The Strategic Group Concept and the Industry Life Cycle

Fizaine (1968: 606-20) examined 1,183 establishments in the French economy and found that age is a better explanatory variable than size in determining growth. Mueller (1972: 210) concludes from these results that "...Young firms grow faster than old ones regardless of their size, and that large and small firms of the same age have the same growth rate." These results seem to have significant implications for the strategic group concept, as it relates to the industry life cycle. That is, newer firms (young firms) would tend to grow faster than older established firms. Consequently, newer entrants into an industry are not necessarily in the same stage of the industry life cycle as the older established firms. Moreover, it is very clear from Newman (1978: 417-427) and Porter (1979: 214-227) that all firms within an industry are not within the same strategic group. It follows, therefore, that all firms within an industry need not be in the same stage of the industry life cycle! This likelihood is consistent with the earlier comment attributed to Porter (1980: 162), that concentration changes as industries develop, as does the level of fragmentation. These changes, too, indicate pressure moving firms toward different stages of the life cycle as well as toward membership in different strategic groups within the same industry.

As mentioned by Porter (1980: 158), Shepherd (1979: 193) also points out that

> The "normal" life cycle is occasionally broken, as new conditions change a mature industry back into

> a young one. Still age often explains much of an industry's structure, behavior, and degree of flexibility.

Shepherd's comment is not inconsistent with the position taken here; that is, the industry life cycle may change. However, neither Shepherd nor any previous author, to my knowledge, has mentioned the possibility that all firms within an industry may not be in the same stage of the life cycle or that different strategic groups may be in different stages of the industry life cycle.

## METHOD

As mentioned earlier, one of the main purposes of this study is to develop a method to identify the stage of the life cycle in which an industry is operating and to determine whether all firms in that industry are in the same stage of the life cycle.

One might suggest several different approaches to answering the above questions. However, it is highly likely that the suggested approach to providing an answer would involve considerable judgment on the part of the investigator. One essential characteristic of the method suggested here is that it is, to the greatest extent possible, free of judgment on the part of the investigator; neither does it rely on responses to questionnaires where firms "tell" you the stage of the life cycle they are in nor does it depend upon judgment of the investigator in observing the behavior of the firm. Instead, hard data, accompanied by the use of rigorous statistical methods, reveal the answers to the questions.

Firm data are readily available to researchers through Compustat tapes and similar sources. Individual firm data, of course, can be summed to obtain industry data. So the researcher has access to both industry and firm data. Even if all data are not actually available for all firms in a

given industry, an aggregation of the available data will provide information which is truly representative of the industry. In the final analysis, that is what really matters.

The next step in the process is to search the literature for some good statistical models which have been developed to examine certain firm or industry behavior. In this phase, I am suggesting that one could benefit substantially by reviewing the economics, management, marketing, management science, and finance literature. These disciplines all have much common ground; if there is a useful method or model in another discipline, we should be willing and eager to accept and adopt it for our purposes, assuming it is a valid approach and adaptable for our purposes.

To illustrate the main point in the previous paragraph, the following discussion focuses attention on the specific problems posed in this paper; and it illustrates a sound approach to answering the questions posed earlier.

Investment behavior is one important indicator of the industry life cycle. Porter (1980: 163) mentions that "...instrumental in much industry evolution are the investment decisions by both existing firms in the industry and the new entrants. In response to pressures or incentives created by the evolutionary process, firms invest to take advantage of possibilities for new marketing approaches, new manufacturing facilities, and the like, which shift entry barriers, alter relative power against suppliers and buyers and so on." The main points for our purpose is that investment decisions are a key variable and that firms adjust this variable as industry evolution takes place, according to Porter.

Lawrence Klein (1951), a Nobel prize winning economist and excellent econometrician, developed a model of investment behavior in the railroad industry. Klein's objective was to model the investment behavior which

actually took place in the industry from 1922 to 1941. He developed two alternative specifications which were able to explain between .903 and .941 percent of variations in investment in the industry.

Kmenta and Williamson (1966: 172-181) in a subsequent study explained that, although Klein's model had important merit, his estimates could have been improved if he had focused attention on the stages of the life cycle of the railroad industry. They used some new data which had recently become available and tested Klein's model. Then they used the same data in their new life cycle model. The results were that they did, indeed, improve upon the estimates which came from Klein's model. The significant fact is that they essentially established that there had been life cycle stages in the railroad industry. They used a three stage cycle; growth, maturity, and senility. Kmenta and Williamson (1966: 180) explain that their analysis could probably be readily adapted to study other industries for which we now have time series data.

The equations used in the Kmenta and Williamson paper are as follows:

stage of adolescence

$$(1)\quad I_t^N = A + B_1 X_{t-2} - B_2 K_{t-2} + B_3 \left(\frac{\pi^*}{K}\right)_{t-2} + B_4 (\pi^*_{t-1} - \pi^*_{t-2}) + \hat{U}_t$$

stage of maturity:

$$(2)\quad I_t^N = A + B_1 X_{t-2} - B_2 K_{t-2} + \hat{U}_t$$

stage of senility:

$$(3)\quad I_t^N = A - B_1 K_{t-1} + B_2 \pi^{**}_{t-1} + \hat{U}_t$$

Where:

$I^N$ = net investment deflated by q (millions of dollars),

X = operating revenue deflated by q (millions of dollars),

K = capital stock deflated by q (millions of dollars),

$\pi^*$ = net operating income excluding depreciation deflated by q (millions of dollars),

$\pi^{**}$ = net income deflated by q (millions of dollars), and

$\frac{\pi^*}{K}$ in (1) is given in percentage rates.

q = railroad construction index, 1929=100.

The kind of research undertaken by Kmenta and Williamson is very valuable and useful to those who are concerned and interested in questions of policy and strategy. Moreover, in this particular work, researchers have a vehicle for answering some very important questions concerning the industry life cycle.

At the beginning of this discussion, I wish to acknowledge that many readers have the ability to "build their own" econometric models. That point is not at issue. The fact is that it is possible to adapt previously published research, which has already been given the "stamp of approval," to further develop some insight into previously unanswered questions.

With the Kmenta and Williamson work we have a model of industry life cycle investment behavior. The authors are excellent econometricians so it is fairly safe to assume that the work is sound. This being the case, if one used their model to develop multiple regression equations for any given industry, one of the three life cycle equations would best fit the data of the industry being examined. That equation would indicate the investment behavior within the industry and would identify the stage of the life cycle of that industry.

## APPLICATION OF THE TECHNIQUE

This section presents an application of the method discussed above by using actual data for firms in the petroleum industry.[2]

This practical application involves the following steps. The research begins with available data since World War II; 1961-1980, representing

twenty years of operation. The raw firm data for the petroleum industry was taken from Compustat tapes. These firm data were summed to obtain industry data. Then, the three investment life cycle equations from Kmenta and Williamson were individually estimated with the same industry data. The model of the stage which best reflects industry investment behavior would identify the stage of the life cycle the industry is actually in. This approach would permit a researcher to gain a better understanding of the investment strategy and behavior of the industry as a whole; in a real sense, the industry life cycle stage would be identified.

Table 1 presents multiple regression equations for the petroleum industry for the three different stages of the industry life cycle presented by Kmenta and Williamson; their model was modified to add an interest rate variable ($r_{t-1}$) and a research and development variable (t). Neither variable was included in their railroad industry study because it was thought that the effects would be unimportant, given the industry being examined. Obviously, an adaptation of the models to most other industries would require R & D and interest rate variables.[3]

The industry equations are (1), (4), and (7). The results show that equation (1), representing the adolescence stage of the industry life cycle seems to best fit the industry data. That is, according to $\bar{R}^2$, the adolescence equation explains a greater percentage of change in net investment for the whole petroleum industry (.79) than either the maturity stage (.25) or the senility stage (.31). From these results, then, a researcher would identify the petroleum industry (that is the aggregate of all firms) as being in the adolescence stage of the industry life cycle. This approach clearly constitutes an important aide for a better understanding of the industry life cycle.

TABLE 1

MULTIPLE REGRESSION EQUATION OF LIFE CYCLE STAGES
PETROLEUM INDUSTRY

$$I_t^N = A + B_1 X_{t-2} - B_2 K_{t-2} + B_3 \left(\frac{\pi^*}{K}\right)_{t-2} + B_4 (\pi^*_{t-1} - \pi^*_{t-2}) + B_5 r_{t-1} + B_6 t + U_t$$

ADOLESCENCE STAGE

| | | A | $B_1$ | $B_2$ | $B_3$ | $B_4$ | $B_5$ | $B_6$ | $\bar{R}^2$ | D.W. |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) | INDUSTRY | 5875.2 | 0.126 | -0.163 | -22454 | 0.056 | 57.497 | 121.71 | 0.795 | 1.964 |
| | | (5332.4) | (0.041)*** | (0.167) | (16050.) | (0.129) | (284.36) | (662.34) | | |
| (2) | LEADING | 1053.2 | 0.041 | 0.004 | -4833.6 | -0.128 | -38.947 | 49.786 | 0.316 | 2.117 |
| | FIRMS | (4566.9) | (0.084) | (0.334) | (4840.9) | (0.149) | (135.51) | (411.95) | | |
| (3) | FOLLOWING | 6828.7 | 0.176 | -0.398 | -28422.0 | 0.145 | 6.912 | 423.16 | 0.810 | 2.018 |
| | FIRMS | (3085.7)** | (0.047)*** | (0.151)* | (17082.0)* | (0.170) | (221.03) | (402.84) | | |

$$I_t^N = A + B_1 X_{t-2} - B_2 K_{t-2} + B_3 r_{t-1} + B_4 t + U_t$$

MATURITY STAGE

| | | A | $B_1$ | $B_2$ | $B_3$ | $B_4$ | $\bar{R}^2$ | D.W. |
|---|---|---|---|---|---|---|---|---|
| (4) | INDUSTRY | -290.67 | 0.047 | -0.014 | 307.37 | 355.14 | 0.251 | 2.002 |
| | | (1545.9) | (0.037) | (0.179) | (159.80)** | (714.94) | | |
| (5) | LEADING | -254.25 | 0.040 | 0.041 | 57.734 | -24.734 | 0.356 | 2.088 |
| | FIRMS | (3886.3) | (0.061) | (0.285) | (100.85) | (327.75) | | |
| (6) | FOLLOWING | -991.36 | -0.034 | -0.222 | 159.09 | 1671.0 | 0.230 | 2.017 |
| | FIRMS | (1257.0) | (0.044) | (0.174) | (120.76) | (811.13)** | | |

$$I_t^N = A - B_1 K_{t-1} + B_2 \pi^{**}_{t-1} + B_3 r_{t-1} + B_4 t + U_t$$

SENILITY STAGE

| | | A | $B_1$ | $B_2$ | $B_3$ | $B_4$ | $\bar{R}^2$ | D.W. |
|---|---|---|---|---|---|---|---|---|
| (7) | INDUSTRY | -5.742 | -0.112 | 0.120 | 275.28 | 936.01 | 0.314 | 1.954 |
| | | (1711.8) | (0.200) | (0.250) | (161.01)* | (475.21)** | | |
| (8) | LEADING | 2719.0 | -0.199 | 0.154 | 64.288 | 215.19 | 0.436 | 2.031 |
| | FIRMS | (1638.5)* | (0.165) | (0.382) | (75.792) | (87.747)** | | |
| (9) | FOLLOWING | -4544.0 | -0.180 | 0.303 | 263.41 | 45732. | 0.189 | 1.790 |
| | FIRMS | (5699.0) | (0.174) | (0.231) | (104.47)** | (56536.) | | |

***Significant at 1 percent level.
**Significant at 5 percent level.
*Significant at 10 percent level.
Standard errors are in parentheses.

The above discussion does explain how an industry life cycle can be identified, however, it does not explain whether or not all firms within an industry are in the same stage of the life cycle. An adaptation of the strategic group concept, along with the procedure discussed above, was used to generate further useful information and answer this question.

The procedure followed by Porter (1979: 214-227) was employed to identify the strategic groups in the petroleum industry. Porter divided each industry sample into two parts. He used the relative size of a firm in its industry as a proxy for its strategic group membership. Porter (1979: 220). The firms in each industry were divided into two categories, leaders and followers. Leaders were defined as the largest firms in the industry (accounting for approximately 30 percent of industry revenue). Remaining firms constituted the follower group. After the segmentation was made to determine the strategic groups within the industry being examined, the three life cycle investment equations were run for each strategic group. If the two strategic groups were in the same stage of the life cycle, the same investment life cycle stage equation would explain best the investment behavior of both groups; if, however, one life cycle equation explains best one strategic group's investment behavior and another explains the investment of the other strategic group, the conclusion would be that they are in two different stages of the industry life cycle.

Equations (2), (3), (5), (6), (8) and (9) in Table 1 present the results of the strategic groups multiple regressions for the petroleum industry. From these equations, it is possible to determine the stage of the industry life cycle of each strategic group. Equation (8) is clearly the best equation for the leading firm, with $\bar{R}^2$ of .43. This indicates that the leading firms in the petroleum industry reflect investment behavior characteristic

of the senility stage of the industry life cycle. The following firms, in contrast, reflect investment behavior characteristic of the adolescence stage. This is determined from the highest $\bar{R}^2$ for following firms, generated by equation (3), which is .81.

In summary, for the petroleum industry used in this illustration, the industry as a whole reflected investment behavior characteristic of the adolescence stage of the industry life cycle; the leading firms reflected investment behavior characteristic of the senility stage, and the following firms reflected investment behavior characteristic of the adolescence stage. The reasons for the difference in investment behavior between members of the two strategic groups is that the following firms are the younger firms. As Mueller (1972: 210) explained, young firms grow faster than old ones regardless of size. The leading firms clearly reflect different investment behavior from the following firms; consequently, they are in a different stage of the life cycle.

The essential point for our purpose is that multiple regression equations and data have been used to make these identifications instead of less objective methods. Overall, the results show: (1) the method proposed here is useful for identifying the stage of the life cycle an industry is in, (2) the method is useful for determining the life cycle stage strategic group members are in. The results also show: (1) all members of strategic groups need not be in the same life cycle stage, (2) the industry life cycle and the life cycle of each strategic group could differ, although one strategic group did match the industry in the illustration presented here.

A question may be raised about the validity of Porter's designation of 30 percent representing the leading group. In fact, he refers to the 30 percent designation as arbitrary. Porter (1979: 220). Indeed, it may be

that instead of two strategic groups, three may exist; and the appropriate breakdown should be, say, one strategic group accounting for 20 percent of sales, another accounting for 30 percent of sales and another accounting for 50 percent.

The results from this alternative strategic group designation could surpass the results of the Porter (1979) analysis. More than likely, some industries will be represented best by three strategic groups, while others will be best identified with two, as Porter (1979: 221) suggests. As McGee (1982) indicates, there are also other methods for determining strategic groups. Porter's (1979) basic designation was arbitrarily selected for this example. The technique explained here readily permits statistical tests to assess the efficacy of one method of strategic group determination versus available alternatives.

One might still remain unconvinced even after the industry life cycle stage has been identified and a determination made concerning the applicability of the life cycle to the strategic groups in the industry. One might assert that even though the equations make the identifications from hard data that the real life cycle may be different from the one indicated. This type of skepticism cannot be easily overcome. One can certainly conclude that the results do mean that the firms, as a strategic group within an industry, are behaving as if they are in a certain stage of the industry life cycle, with respect to their investment decisions. These conclusions would follow from the hard data and the rigorous statistical analyses which are used. Admittedly, the analyses may not generate conclusive proof; however, the results should certainly be more credible than judgments made from instinct, hunch, speculation or even firm surveys.

Given several studies of the type suggested here, we should be able to make much stronger industry analyses and understand better industry life cycles and strategic groups. This conclusion follows because the composition of strategic groups is probably not independent of the industry life cycle, yet previous analyses have tended to assume that is the case.

## CONCLUSIONS

In contrast to methods which rely on hunch and speculation to identify the industry life cycle or the strategic groups of an industry, the method advocated in this study is dependent upon rigorous statistical analysis. Although researchers could develop their own econometric models to make desired identifications, models which have been developed by previous research may be readily adaptable to answer relevant questions.

Although the primary focus here has been upon the industry life cycle and strategic groups, it is almost certain that other important questions, of interest to the study of strategic management, could also be answered in a similar fashion. This basic approach could substitute rigor for subjective judgment wherever it is used.

An additional point can be made concerning the value of industry life cycle analyses. Kmenta and Williamson (1966) show the importance of examining industry data with life cycle models. Their analysis provides rather strong evidence that those concerned with industry analysis and strategy must take the industry life cycle concept seriously. This conclusion follows from their whole analysis and is adequately summed up in one of their final comments.

> All of this suggests considerable potential for the life-cycle approach as contrasted to models which disregard the stage of industry development. Kmenta and Williamson (1966, p. 180).

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## FOOTNOTES

[1]The industry life cycle and the market or industry evolution cycle are essentially the same thing. See also: Biggadike (1981: 631) and Porter (1981: 609-620).

[2]The method is most useful for firms with a minimum degree of diversification. Of course, it is possible to control for diversification differences, to some extent.

[3]The interest rate proxy variable ($r_{t-1}$) is the real corporate bond rate, lagged 1 year. Specifically, the industrial average was used for the industry equations; the triple A (AAA) rate was used for the leading firms; and the double A (AA) rate was used for the following firms. The R & D variable is a time trend variable (1 in the first time period, n in the final time period). An additional modification of the Kmenta and Williamson model, involved the price deflator, q. For this study, q is the implicit price deflator for producers durable equipment.

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